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Revision of *Aresceutica* (Orthoptera: Acrididae: Catantopinae) with comments on related genera

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Abstract

The East African forest genus *Aresceutica* Karsch is revised; there are now four valid species, including *A. nguruensis*, **sp. n.** from south eastern Tanzania. *Aresceutica* is extremely similar to the West African genus *Serpusia*; it differs only in the form of the prosternal tubercle and the detail of the phallic morphology. Two new combinations are proposed: *Ptemoblax lemarineli* Bolívar, 1911 = *Aresceutica lemarineli* (Bolívar, 1911), **comb. n.** and *Aresceutica vansomereni* Kevan, 1956 = *Duviardia vansomereni* (Kevan 1956), **comb. n.**

Key words

East Africa, grasshopper, taxonomy

Introduction

The genera *Aresceutica* Karsch, 1896, *Serpusia* Karsch, 1891, *Pseudophialosphera* Dirsh, 1952, and *Veseyacris* Dirsh, 1959, are morphologically similar, flightless Catantopine grasshoppers, found in the leaf litter or on the understory herbaceous vegetation of wet forests in equatorial Africa. Their great external similarity led Johnston (1956) to group the first three of these genera (*Veseyacris* was described later), together with *Segellia* Karsch, 1891, *Auloserpusia* Rehn, 1914, *Pteropera* Karsch, 1891, *Coenona* Karsch, 1896 and *Serpusilla* Ramme, 1931 in a subtribe Serpusiae. Dirsh (1975) retained Johnston's (1956) subtribe, but transferred it to a new subfamily Apobolinae, which has not found favor with subsequent authors. Otte (1995) reduced Dirsh's (1975) Apobolinae to a tribe (Apoboleini Johnston, 1956) of the Catantopinae, but transferred all the genera of the Serpusiae to an uncertain position within the Catantopinae. The OSF (Cigliano et al. 2018) has, however, restored these genera to a "genus group" Serpusiae Johnston, 1956, thus re-establishing Johnston's (1956) original arrangement. The specific composition of these genera has been rather unstable, partly due to the difficulty of distinguishing between them. Thus, *Ptemoblax insidiosus* Bolívar, 1908 was synonomized with *Serpusia succursor* Karsch, 1896 by Johnston (1956); *Ptemoblax lemarineli* Bolívar, 1911 was reassigned to *Serpusia* without explanation by Dirsh (1955).

While editing unpublished manuscripts by the late N.D. Jago, the present authors (C.H.F.R. and C.H.) came across the following statements: "Dirsh (1970) included *Aresceutica lemarineli* in the genus *Serpusia* s. lat. (however, examination of material from West Africa shows that, on the basis of male genital morphology, *Serpusia* should contain only *S. opacula* Karsch and *S. succursor* (Karsch) (W. Zaire to Cameroon and S.E. Nigeria). Moreover, *Serpusia catamita* Karsch (Togo, Ghana) and another new species from Guinea and Liberia should be removed from *Serpusia* and placed in a new genus). This makes the genus *Aresceutica* almost entirely East African, though *A. lemarineli* is also common in eastern Zaire. All genera and species in this group of closely related insects are reliably identifiable using male genitalia, other characters, e.g. black varnish on tegmina, green coloration, size, etc., being open to considerable variation. Note that a publishing error in Dirsh (1965) added to the confusion by interchanging the figures of *Serpusia lemarineli* with that of *Aresceutica subnuda*."

Jago (1970) had earlier discussed the very close relationships between the genera of the Serpusiae, and even considered the possibility of synonomizing *Serpusia* in part with *Auloserpusia* and in part with *Aresceutica*.

In this paper we follow Jago's (1970) lead, and have revised the genus *Aresceutica*. We also compared the male internal genitalia of *lemarineli* with those of all known *Aresceutica* spp. and with those of *Serpusia opacula*, the type species of its genus, and of *S. succursor*. We conclude that *lemarineli* is not a *Serpusia*, but is indeed a member of *Aresceutica*, and formally transfer it to that genus. *Aresceutica vansomereni* Kevan, 1956, on the other hand, differs from the rest of the genus, and we here transfer it to *Duviardia* Donskoff, 1985, on the basis of its phallic structures. We further describe a new species of *Aresceutica* from the Nguru Mountains of Tanzania. We have not examined critically the other genera of the Serpusiae, nor other West African species currently ascribed to *Serpusia*.

Materials and methods

Aresceutica species were collected in Kenya and Tanzania by C.H. and by N.D.J., and *Serpusia* species (including *S. lemarineli*) by C.H.F.R. in Uganda and Cameroon. Further Cameroon material was kindly provided by C. Oumarou Ngoute. The provenance of the specimens used for phallic preparations is shown in Table 1.

Phallic preparations used standard methods: the dried pinned specimens were rehydrated in water before dissection, the extracted phallic complexes were macerated in 8% KOH and extraneous tissue removed, and then neutralized in 5% acetic acid, followed by staining in acid fuchsin. Drawings were made under 25× magnification with a Wild M5 microscope equipped with a drawing tube, digitized, and then refined in PHOTOSHOP C5 (Adobe). Measurements were taken using the stereo microscope with a graticule eyepiece and a digital stage (Mitutoyo) reading to 0.01 mm.

In all the figures of phalli in this article, the epi- and endophallic sclerites are shown in darker shading, the ectophallic sclerites in lighter shading. The ejaculatory and spermatophore sacs are indicated with coarse stipple, other membrane with light stipple.

Results

Aresceutica Karsch, 1896

Figs 1–6

Type species.—*Aresceutica subnuda* Karsch, 1896

Description.—(modified from Dirsh 1965) Male. Medium size. Cuticle finely or moderately roughened. Antennae slender, their length longer than, equal to, or shorter than length of head and pronotum combined. Fastigium of vertex short, flat or slightly concave, apex truncate. Frons slightly oblique; frontal ridge with straight sides along whole length, slightly produced forward between the antennae. Pronotum sub-cylindrical, disc crossed by transverse sulci 2-4, sometimes (*A. lemarineli*) weakly depressed just behind transverse sulcus 4; median carinula weak to fairly distinct; metazona much shorter than prozona. Anterior and posterior margins of pronotum straight or weakly convex, often slightly emarginate in midline. Prosternal tubercle subconical, antero-posteriorly compressed, tilting somewhat backwards. Tegmina lateral, strap-like, partially covering tympanum. Tympanum present. Legs slender; external apical spine of hind tibiae absent; arolium enlarged. Medial carina well marked in proximal 7 abdominal segments, obsolete distally. Male supra-anal plate elongate, angular. Cercus simple, acutely pointed. Subgenital plate short, subconical.

Female. Ovipositor long, with slender valves curved at apices.

Key to species in the genus *Aresceutica* (males)

1. Supra-anal plate longer than its basal width 2
1A. Supra-anal plate with length equal to its basal width 3
2. Antennae longer than head and pronotum together. Pronotal lateral lobe polished dark brown to black; light ventro-posterior patch widest at posterior pronotal margin, extends tapering forwards to prothoracic episternum. Tegminal apex rounded; reaching to rear margin of tympanum or sometimes to middle of abdominal tergite 2. Underside of thorax and abdomen dull ochreous yellow. Two clear pale creamy spots on lower part of outer area of hind femur, basal one 4x longer than deep. Ventral inner and lower outer areas dull dark crimson. Inner area of hind femur black. Hind tibiae: dull brownish near knee, apically orange-red, spines orange red, black tipped (N.E. TANZANIA, East and West Usambara Mts.; S.E. KENYA, Shimba Hills)..... *subnuda* Karsch, 1896
2A. Antennae longer than head and pronotum together. Pronotal lateral lobe black or dark brown, usually not polished. Light ventro-posterior patch sometimes present, variable in clarity and distinctness, extending from rear margin of lobe to third transverse sulcus. Tegminal apex rounded, extends barely into second abdominal tergite. Underside of thorax and abdomen dull ochreous yellow, usually suffused with crimson. Hind femur mottled dark brown, with no distinct light patches on outer face, lower outer and lower inner areas crimson; inner area mostly black, crimson ventrally and basally. Hind tibia brown by knee, distally crimson, spines colored correspondingly, black tipped (Eastern D.R. CONGO; N.W. RWANDA; Southern and Western UGANDA; Western KENYA, Kakamega forest)..... *lemarineli* (Bolívar, 1911), comb. n.
3. Antennae same length as that of head and pronotum combined. Pronotal disc with pair of dorso-lateral, shallowly incurved, pale lines, which approach each other most closely at level of transverse sulcus 2. Tegminal tips rounded, just overlapping base of abdominal segment 2. Episternum T3 clearly marked in light ochre. Underside of

Table 1. Provenances of specimens used for phallic preparations.

Genus	Species	Country	Locality	Collection date	Collector
Aresceutica	*subnuda* Karsch, 1891	Tanzania	Lutindi Mental Hospital	Jan. 2016	C. Hemp
	subnuda Karsch, 1891	Kenya	Shimba Hills Nat. Reserve, Makadara Picnic Site	Jun. 1981	M. Ritchie
	subnuda Karsch, 1891	Tanzania	Sigi, nr. Tanga	Dec. 1955	No data
	morogorica Dirsh, 1954	Tanzania	Forest above Morningside, Uluguru Mts.	Jan. 2016	C. Hemp
	morogorica Dirsh, 1954	Tanzania	Mangula Gate, Udzungwa Mountains	Jan. 2015	C. Hemp
	morogorica Dirsh, 1954	Tanzania	Bunduki Forest Reserve, Uluguru Mts.	Oct. 1964	N.D. Jago
	nguruensis sp. n.	Tanzania	Forest above Turiani, Nguru Mts.	Jan. 2016	C. Hemp
	nguruensis sp. n.	Tanzania	Forest above Turiani, Nguru Mts.	Nov. 1964	N.D. Jago
	lemarineli (Bolívar, 1911)	Uganda	Mabira Forest, Buganda	Mar. 2013	C.H.F. Rowell
	lemarineli (Bolívar, 1911)	Uganda	Mpanga Forest, Buganda	Mar. 1998	C.H.F. Rowell
Serpusia	*opacula* (Karsch, 1891)	Cameroon	Ongot, C. Cameroon	Month? 2014	C. Oumarou Ngoute
	succursor (Karsch, 1896)	Cameroon	S. Bukundu Forest.	Oct. 1971	T.E. Rowell
Duviardia	*vansomereni* (Kevan, 1956)	Kenya	Mt Kenya, montane forest	Mar. 2003	C. Hemp
	vansomereni (Kevan, 1956)	Kenya	Karen	Oct. 1999	C. Hemp

thorax and abdomen dull ochraceous yellow. Outer area of hind femur with two clear creamy spots ventrally; basal one 2x longer than deep. In some specimens there is a third cream spot on the dorsal part of the outer area. Lower outer and lower inner areas of hind femur dark crimson (TANZANIA, Uluguru and Udzungwa Mts.).....
.....*morogorica* Dirsh, 1954

3A. Antennal length greater than that of head and pronotum combined. Pronotal disc rough, matte with irregular dull brown and black markings. Tegminal apex rounded acute, reaching half way across abdominal segment 2. Episternum T3 not clearly demarcated with pale pigment, but colored slightly lighter brown. Underside of thorax and abdomen ochreous yellow. Two pale spots of outer area of hind femur extend dorsally to midline of femur or beyond. Lower outer and lower inner areas of hind femur dark crimson; inner area dark maroon or black. Hind tibia brown by knee, apically crimson (E. TANZANIA, Nguru Mts.) .....*nguruensis* sp. n.

Females are best identified by their associated males.

1. *Aresceutica morogorica* Dirsh, 1954

Figs 2H–I, 3

urn:lsid:Orthoptera.speciesfile.org:TaxonName:56202

Recognition.—Male. Frons, clypeus, labrum, mouthparts, ochraceous yellow, speckled black dorsally. Fastigium, vertex, inter-ocular space, greyish-ochraceous with dark speckle. Genae ochraceous with dark speckle anteriorly, darkening rearwards to solid black at posterior margin. Disc of pronotum dark brown to black. A pair of ochraceous stripes run the length of the pronotal disc, most narrowly separated at level of second transverse sulcus, and continue rearwards on to the vannal area of the tegmina. Pronotal lateral lobes glossy black, with a posterio-ventral pale ochraceous patch tapering forward to end on prothoracic episternum. Meso- and metathoracic pleura black, metathoracic episternum striped with ochre. Tegmina black apart from the lighter vannal region mentioned above. Abdominal tergites in midline ochraceous with black speckle, laterally black. Pro- and mesothoric legs mottled olive green and ochre. Hind femur: dorsal inner and outer faces ochraceous brown. Outer area suffused blackish, with black chevron markings. Ventral margin of outer area bears two ochraceous patches, the basal patch being twice the length of the distal patch; in some individuals there is a third patch on the dorsal margin of the outer area. Ventral inner and outer faces of femur crimson. Internal face black. Hind knees brown. Hind tibia brown proximally, shading to crimson distally. Spines brown with black tips.

Female. Similar to male but larger, darker and generally more dully colored. Ochraceous areas of male are light brown in female. Pronotal disc is devoid of light stripes. Tegmina often bear one or two shiny black patches.

Note: The color pattern of *A. morogorica* is very similar to that of *Veseyacris*.

Measurements.—

Size (mm)	Males (N = 8)	Females (N = 8)
Posterior femur length	12.12–12.48	15.4–17.71
Posterior femur depth	2.93–3.07	3.98–4.25
Total length*	18.5–22.53	25.1–32.9

(*frons to tip of abdomen)

Distribution.—TANZANIA: Uluguru Mts, above Morogoro, and Udzungwa Mountains National Park.

2. *Aresceutica subnuda* Karsch, 1896

Figs 2J–K, 4

urn:lsid:Orthoptera.speciesfile.org:TaxonName:56198

Description.—Male. Frons, clypeus and labrum, light ochre brown with darker speckles. Pronotal disc dark brown, pitted and roughened overall. A pair of irregular orange brown stripes run along lateral margins of pronotal disc and continue onto anal area of tegmina. Rear margin of pronotal metazona straight or slightly convex, with a minute emargination in the midline. Side of pronotum polished dark-brown to black; light ventro-lateral patch tapers forward to end on prothoracic episternum. Metathoracic episternum striped in lighter ochraceous color. Tips of tegmina reach to posterior margin of tympanum or to midpoint of abdominal segment 2; black varnished regions common on tegmina in front of R1/Sc veins and in R /M areas near tip. Underside of thorax and abdomen dull ochraceous yellow, with no red suffusion.

Two clear pale creamy spots on lower part of outer area of hind femur; basal one four times longer than deep. Lower inner and lower outer areas of hind femur dull dark crimson. Inner area of hind femur black. Hind tibiae dull brownish near knee, apically orange-red, spines orange red, black tipped.

Measurements.—

Size (mm)	Males (N = 6)	Females (N = 6)
Posterior femur length	11.46–13.2	16.81–19.2
Posterior femur depth	2.42–3.2	3.8–4.3
Total length*	18.65–19.80	26.6–31.13

(*frons to tip of abdomen)

Distribution.—TANZANIA: West and East Usambara Mts., Tanga region. KENYA: Shimba Hills.

3. *Aresceutica nguruensis* sp. n.

Figs 1E–G, 5

http://zoobank.org/5AA3AEAC-68F1-4278-9111-DAFC4395FDE0

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Holotype male.—TANZANIA, Nguru Mts, forest above Turiani, Mhonda. ii. 2017 (C. Hemp). NHML.

Allotype female.—Same data as holotype.

Paratypes.—TANZANIA, Nguru Mts., forest above Turiani, (5-7) xi. 1964, (N.D. Jago). 1 male (NHML). TANZANIA 2 males, 4 females, same data as holotype but March (2 females), June (1 male, 2 females) and November 2017 (1 male) (Hemp coll. 2 males, 5 females, TANZANIA, same data as holotype but January, 2018 (Hemp coll.).

Description.—Male. (See key). Antennae basally brown, distally black, longer than head and pronotum combined. Head and mouthparts generally ochraceous yellow with sparse black speckle, but genae suffused with black. Pronotal disc finely and densely pitted but not matte, uniform brown with no paler longitudinal stripes. Rear margin of metanotum almost straight, hardly at all emarginate in midline. Pronotal lateral lobe polished dark brown, almost black; posterio-ventral corner occupied by a triangular wedge of light brown which tapers forward to end on the prothoracic episternum. Meso and metathoracic pleura dark brown with irregular black markings; metathoracic episternum with a weak lighter stripe. Tegmen dark brown, polished black along the costal margin, often also on medio-medial area. Abdominal

tergites ochraceous dorsally, black laterally. Cerci black. Hind femur as in *A. morogorica*, but pale patches on outer area are deeper, extending upwards to midline of femur. Hind tibiae and tarsi red. Fore and middle femora ochraceous, often touched with green apically.

Aresceutica nguruensis is very similar to *A. morogorica*, differing only in details of coloration, in having longer antennae, and being slightly larger.

Measurements.—

Size (mm)	Males (N = 3)	Females (N = 5)
Posterior femur length	13.5–14.29	19.0–20.09
Posterior femur depth	3.21–3.24	4.45–4.63
Total length*	20.9–23.02	27.7–33.02

(*frons to tip of abdomen)

Distribution.—TANZANIA: Nguru Mts., above Turiani.

4. *Aresceutica lemarineli* (Bolívar, 1911), comb. n.

Figs 1A–D, 6

urn:lsid:Orthoptera.speciesfile.org:TaxonName:502928

Synonomy: *Ptemoblax lemarineli* Bolívar, 1911: 298 (holotype female, Zaire [= Democratic Republic of the Congo]; in MRAC Tenvuren KMMA).

Serpusia lemarineli (Bolívar, 1911): Dirsh 1955; Johnston 1956.

Ptemoblax vicinus Rehn, 1914: 137 (holotype – female, Zaire, Semliki Valley; in MfN). Synonymized with *Serpusia lemarineli* by Johnston (1956).

Description.—Male. (See key). Antennae basally yellow-brown, distally black, longer than head and pronotum together. Head and mouthparts generally ochraceous yellow with dense black speckle, but genae suffused with black. Pronotal disc densely pittted, uniform brown, usually with no paler longitudinal marks. Medial carina of pronotum relatively well developed, disc surface behind fourth sulcus clearly depressed. Rear margin of metanotum weakly convex, slightly emarginate in midline. Pronotal lateral lobe dark blackish brown; posterio-ventral corner occupied by a triangular wedge of lighter color which extends forward along ventral margin to level of third sulcus. Meso- and metathoracic pleura dark brown, with a variable degree of lighter color striping the episterna and epimera. Tegmen dark brown, polished black along the costal margin. Tip of tegmen rounded or rounded acute, variable between individuals; extends just into second abdominal tergite, partially covering tympanum. Abdominal tergites mainly ochraceous dorsally, with black pigment laterally only in segments A1-4. Underside of abdomen and thorax ochraceous, usually heavily suffused with red. Cerci suffused black. Hind femur brown with blackish green suffusion and no pale patches on outer area. Internal ventral area of hind femur red. Internal face of hind femur red basally, black distally. Hind tibia brown proximally, red distally. First tarsal segment red dorsally, other tarsal segments brown. Fore and middle femora ochraceous, often touched with green apically.

Female. Similar to male, but larger and darker in coloration.

Measurements.—

Size (mm)	Males (N = 2)	Females (N = 1)
Posterior femur length	13.3,12.25	16.69
Posterior femur depth	3.08, 2.98	3.9
Total length*	21.01, 19.21	28.62

(*frons to tip of abdomen)

Distribution.—Eastern D.R. CONGO; N.W. RWANDA; Western and Southern UGANDA; Western KENYA (Kakamega Forest only).

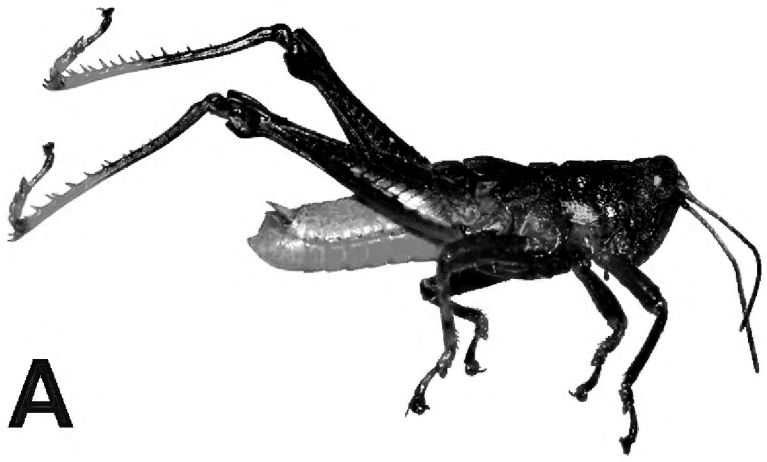
Phallic structures in *Aresceutica* (Figs 3–6)

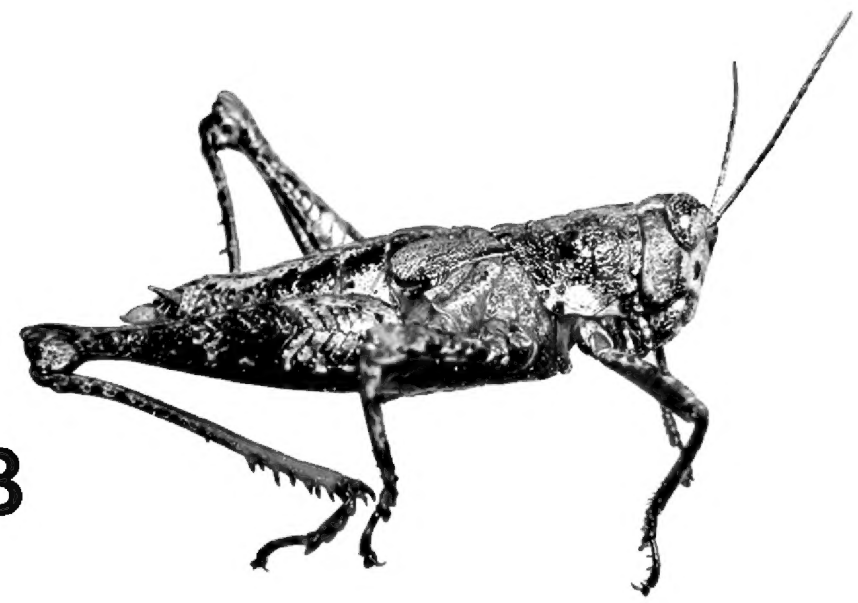
Aresceutica males have a highly characteristic phallus, with little variation between the species. It seems unlikely that the species could be distinguished on the basis of phallic characters alone, though a larger sample size might disclose some specific regularities. The phallus is short, compact and robust, with several unusual features. A glance at these figures will convince that the phallus of *lemarineli* does not differ significantly from those of the previously recognized *Aresceutica* species.

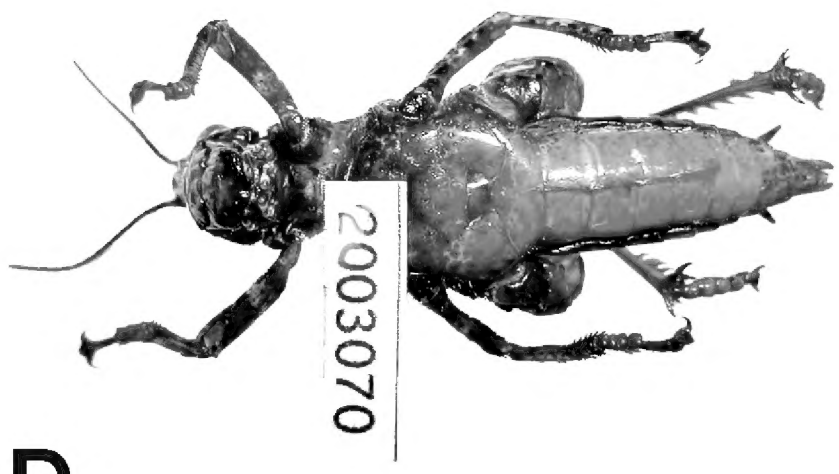
Epiphallus (Figs 3A–C, 4A, 5A–C, 6A–B).—The epiphallus is a narrow bridge connecting two lateral plates which bear small hooked ancorae on their anterior margins, and broad, rounded, widely separated, lobe-like lophi on their posterior margins. Lateral oval sclerites are present, roughly triangular in shape in most species, though oblong and strap-like in *A. lemarineli*. The epiphallic membrane runs backwards from the epiphallus to anchor on the zygoma and the edges of the ectophallic rami; there are no post-epiphallic sclerites, but in some individuals there is a weak oblong thickening of the membrane ventrolaterally, anterior to the the cingular rami.

Ectophallus (Figs 3D–E, 4B–C, 5D–E, 6C–D).—The cingulum has a well-sclerotised zygoma, which bears short, curved cingular apodemes, giving a horseshoe shaped appearance in dorsal view (these are distinctly different from the longer, more orthogonally arranged apodemes of *Serpusia* – see below). The posterior margin of the zygoma forms a projecting ridge, seen as a short beaked projection in lateral view. The ectophallic rami are well developed, roughly oblong in lateral view; they extend to the ventral midline of the phallus, and meet but do not fuse at their ventral extremities. From their posterior margins an ectophallic sheath arises, forming two closely juxtaposed structures: a) a thick semitransparent membrane that covers the aedeagal valves ventro-laterally as they emerge from between the rami, and b) an opaque reinforced ectophallic sheath which envelops the tips of the aedeagal valves. The arch of the cingulum is well developed and forms a saddle-like sclerite on the posterior end of the spermatophore sac below the zygoma. It is rigidly connected to the inner surface of the zygoma by two oblique columns, which have to be cut through to extract the endophallus from the cingulum. Ventrolaterally, there are also connections between the arch and the inner surfaces of the rami. The cingular valves are short and deep, and at their extremities are fused with the inner surface of the ectophallic aedeagal sheath into which they protrude. The anterior margins of the rami bear a fringe of filamentous chitinous material; this fringing material runs from the ventral margin of the ramus upwards along its anterior margin to extend along the ventral edge of the cingular apodemes. A similar fringe is present on the dorsal edge of the proximal endophallic sclerites, and seems to be characteristic of the genus; we do not recall seeing it in other genera.

Endophallus (Figs 3F, 4D–F, 5F–G, 6E–F).—The anterior endophallic apodemes are short and concave, widely separated and arranged at nearly 90° to the long axis of the phallus. The gonopore processes are long and thin, and run backwards to end nearly halfway to the flexure. The ejaculatory sac is large and capacious, roughly spherical. The dorsal surface of the basal endophallic sclerites is







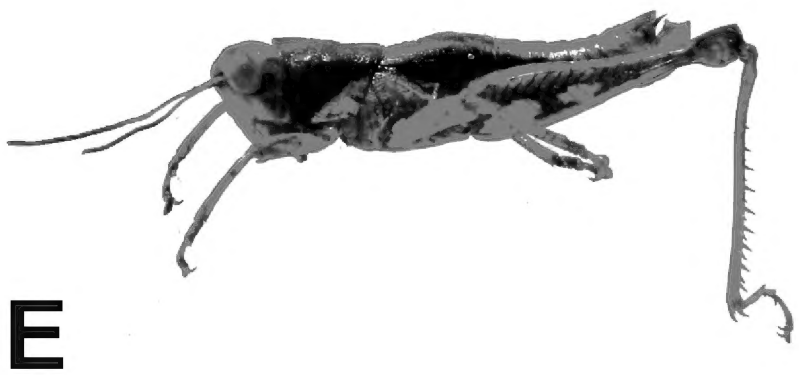


Fig. 1. A–D. *Aresceutica lemarineli* comb. n.: **A.** Male; **B.** Female, lateral; **C.** Female, dorsal, alive; **D.** Female, ventral view, to show characteristic red suffusion; **E–G.** *Aresceutica nguruensis*, sp. n.: **E.** Male holotype, lateral; **F.** Male paratype, lateral; **G.** Female paratype, alive.

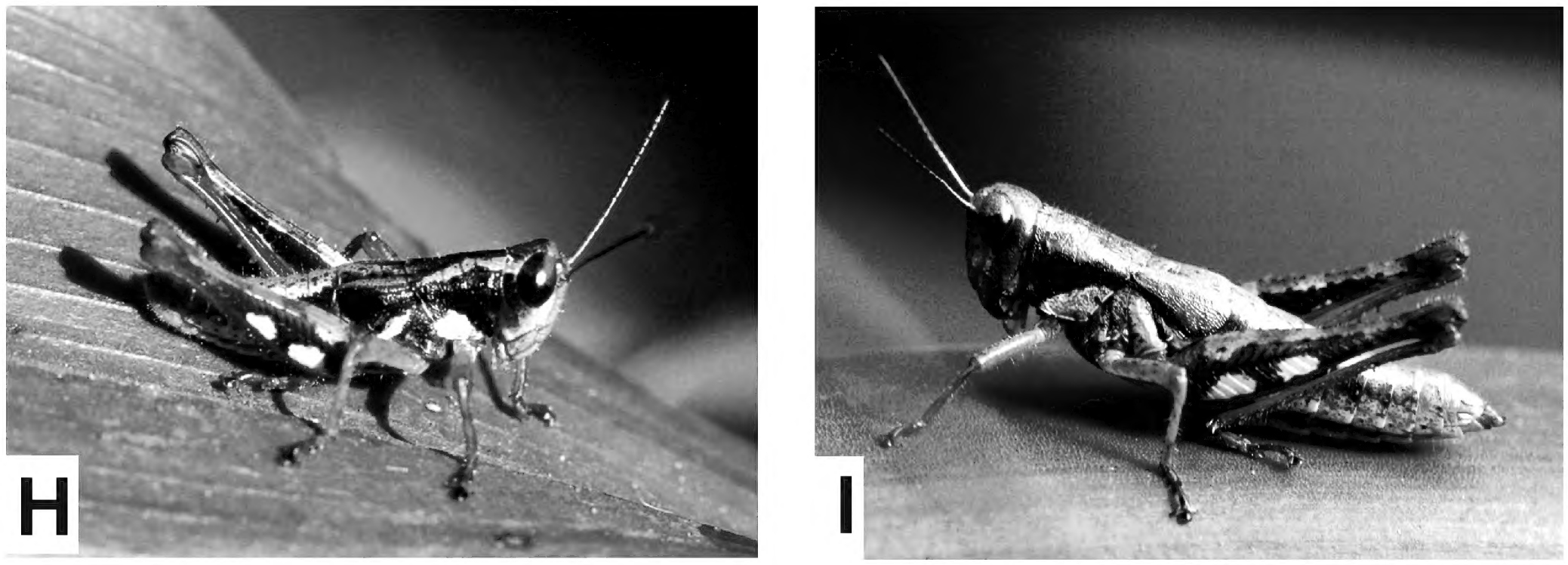


Fig. 2. H–I. *Aresceutica morogorica*: **H.** Male, alive; **I.** Female, alive; **J–K.** *Aresceutica subnuda*: **J.** Male alive; **K.** Male and female, in cop., alive; **L–M.** *Duviardia vansomereni*: **L.** Male alive; **M.** Male and female, in cop., alive.

"ornamented" with a chitinous fringe, as mentioned in the preceding paragraph. The flexure is fine and flexible, S-shaped in lateral view, and connects to the endophallic valves, which are simple slender curved sclerites running beneath the arch and inserting into the ectophallic aedeagal sheath. Like the cingular valves, their tips do not lie free, but instead are fused to the inner wall of the aedeagal sheath. In this genus it seems that the functional aedeagal valves are composed primarily of ectophallic sheath material, rather than of the actual endo- and ectophallic sclerites, which are incorporated into the lateral walls of the sheath.

The complexity of the phallic anatomy within the Serpusiae, and especially of the aedeagus, was previously examined by Jago (1970), in his study of the genus *Auloserpusia*. To elucidate the aedeagal structure he was forced to use the technique of serial microscope sections,

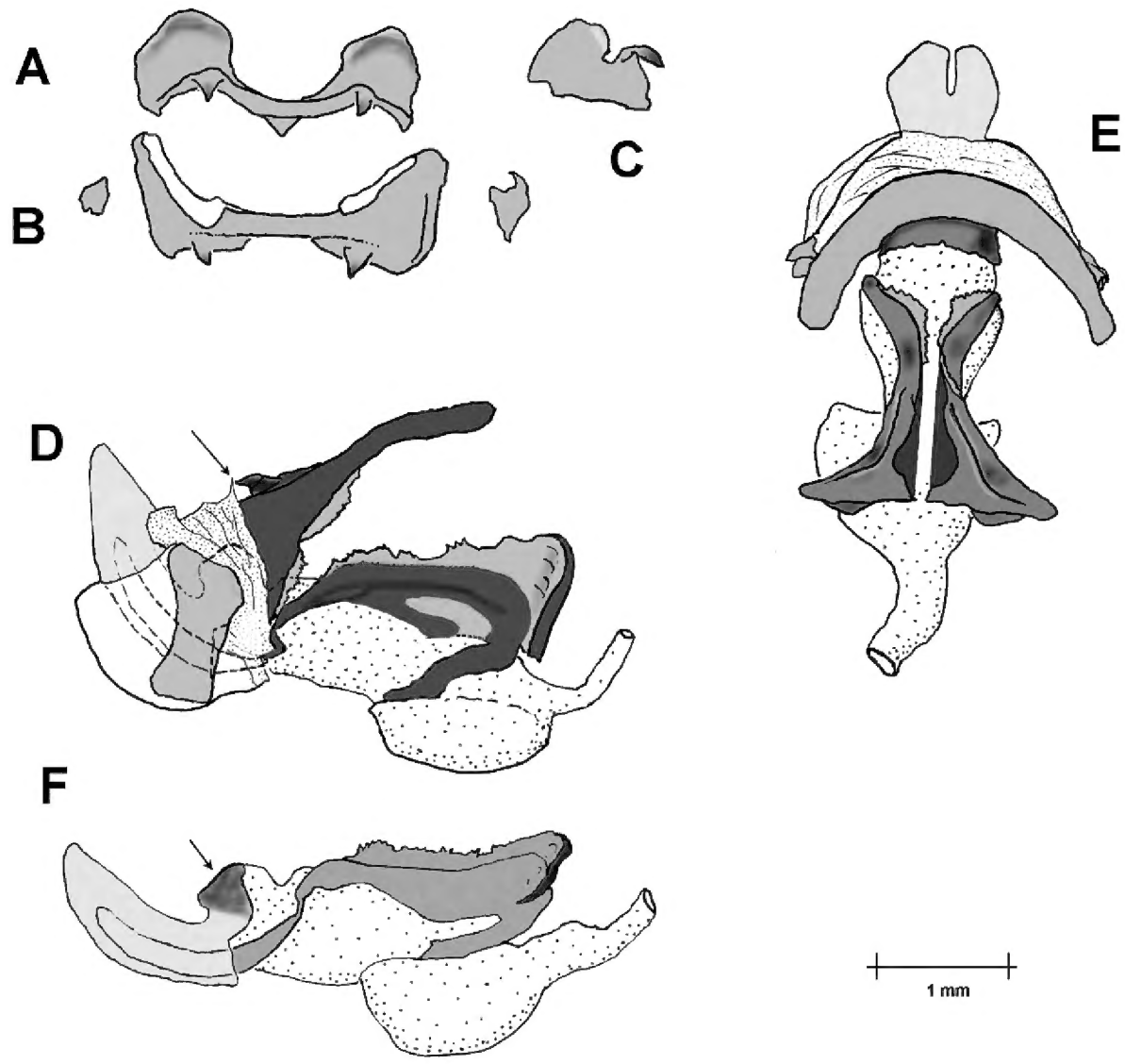


Fig. 3. *Aresceutica morogorica*, phallus. **A.** Epiphallus, axial view; **B.** Epiphallus, and oval sclerites, dorsal view; **C.** Epiphallus, lateral view; **D.** Phallic complex after removal of epiphallus, lateral view. The arrow indicates the cut edge of the epiphallic membrane, where the epiphallus was removed; the remaining epiphallic membrane has dropped down behind the zygoma. In the other figures of this series (i.e. Figs 4–6) this membrane has been dissected off; **E.** As in D, but dorsal view; **F.** Endophallus and arch. The region where the connection between arch and zygoma has been cut is arrowed. The lighter shading indicates the ectophallic aedeagal sheath.

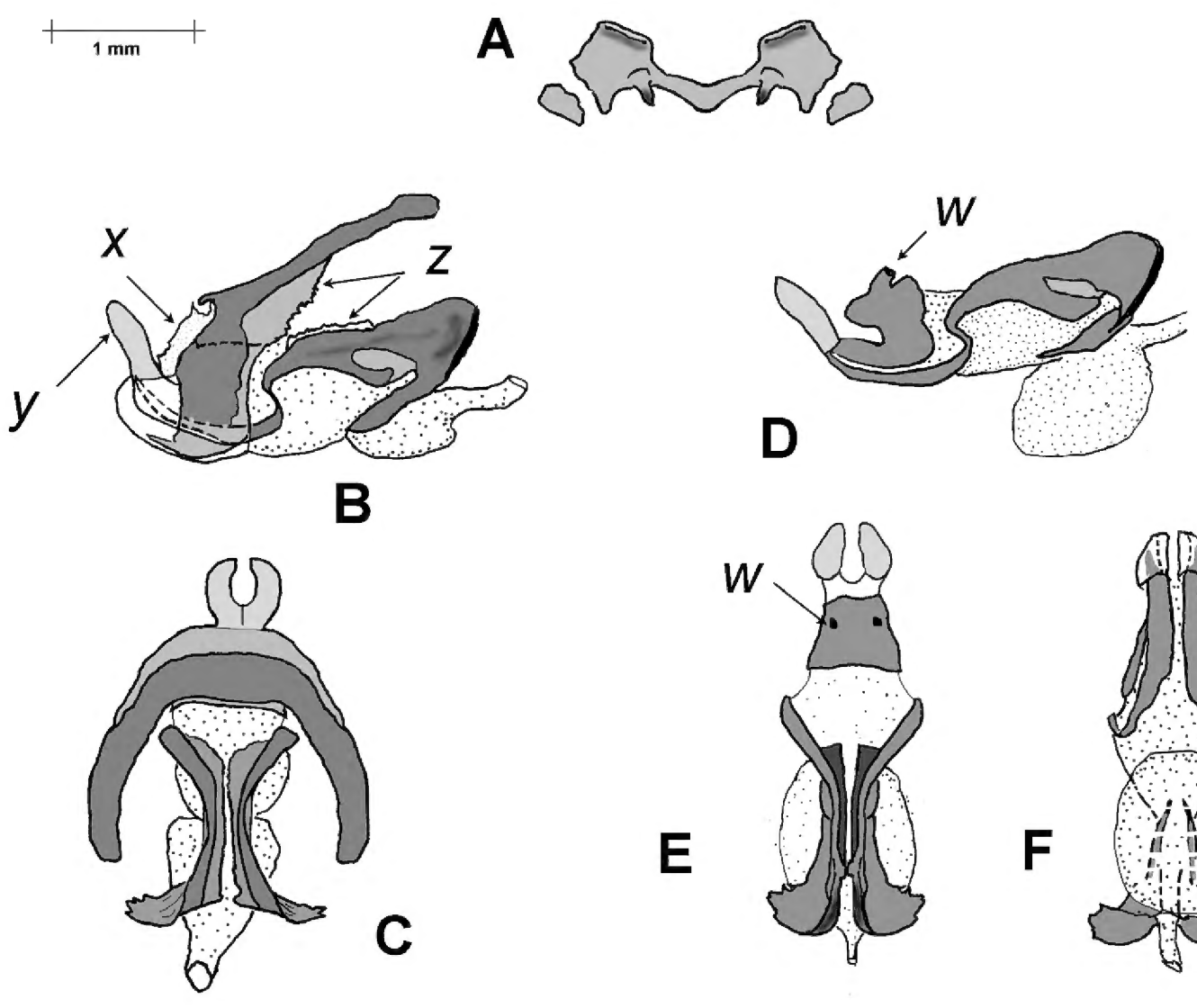


Fig. 4. *Aresceutica subnuda*, phallus. **A.** Epiphallus and oval sclerites, axial view; **B.** Phallic complex after removal of epiphallus and epiphallic membrane, lateral view. x: cut edge of epiphallic membrane. y: aedeagal sheath. z: chitinous fringe to ectophallic ramus and basal endophallic sclerites; **C.** As in B, but dorsal view; **D.** Endophallus and arch of cingulum, lateral view. w: cut attachment of arch to zygoma; **E.** As D, but dorsal view; **F.** As D, but ventral view.

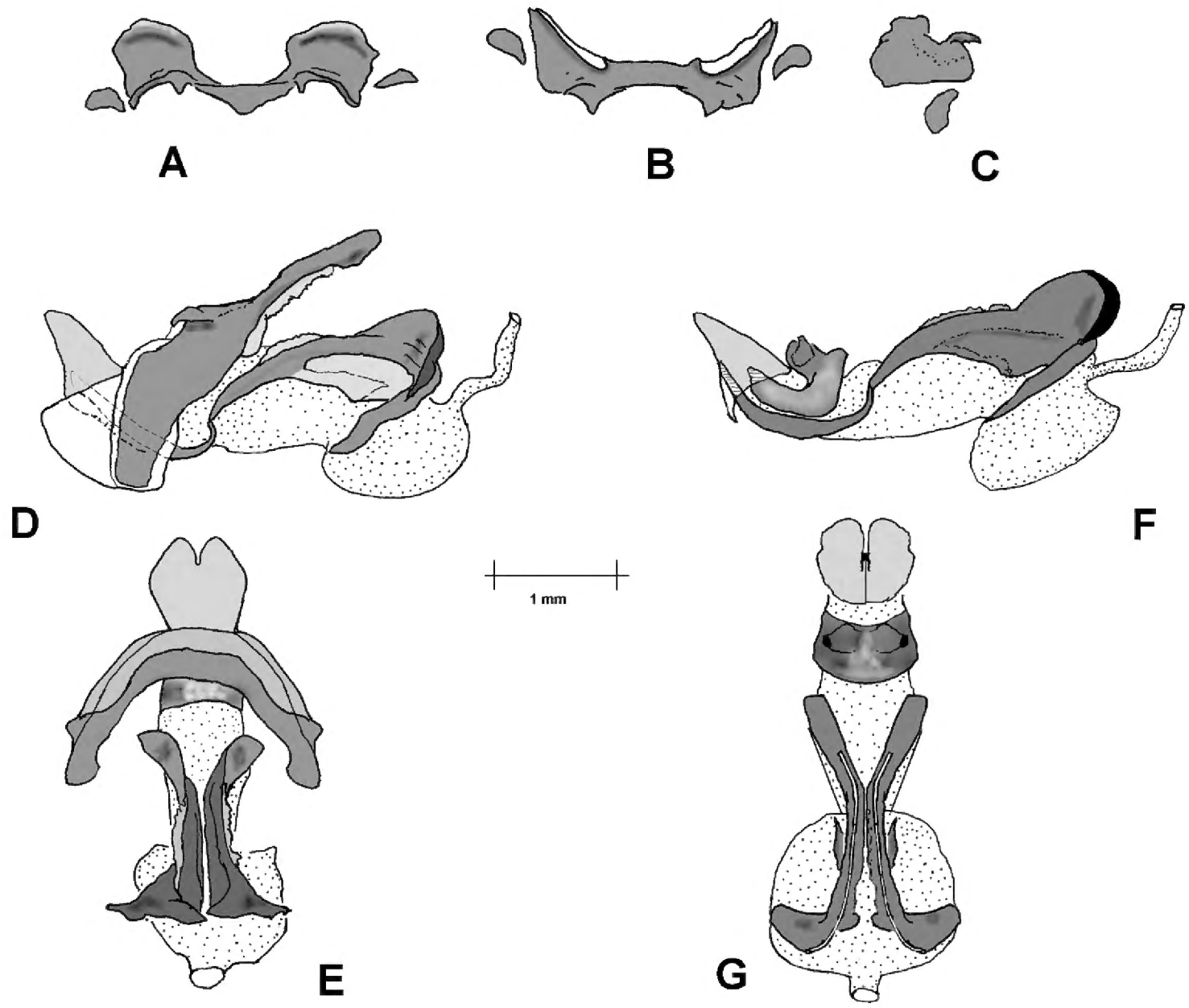


Fig. 5. *Aresceutica nguruensis* sp. n., phallus. **A.** Epiphallus, axial view; **B.** Epiphallus and oval sclerites, dorsal view; **C.** Epiphallus, lateral view; **D.** Phallic complex after removal of epiphallus and epiphallic membrane, lateral view; **E.** As in D, but dorsal view; **F.** Endophallus and arch, lateral view; **G.** As in F, but dorsal view.

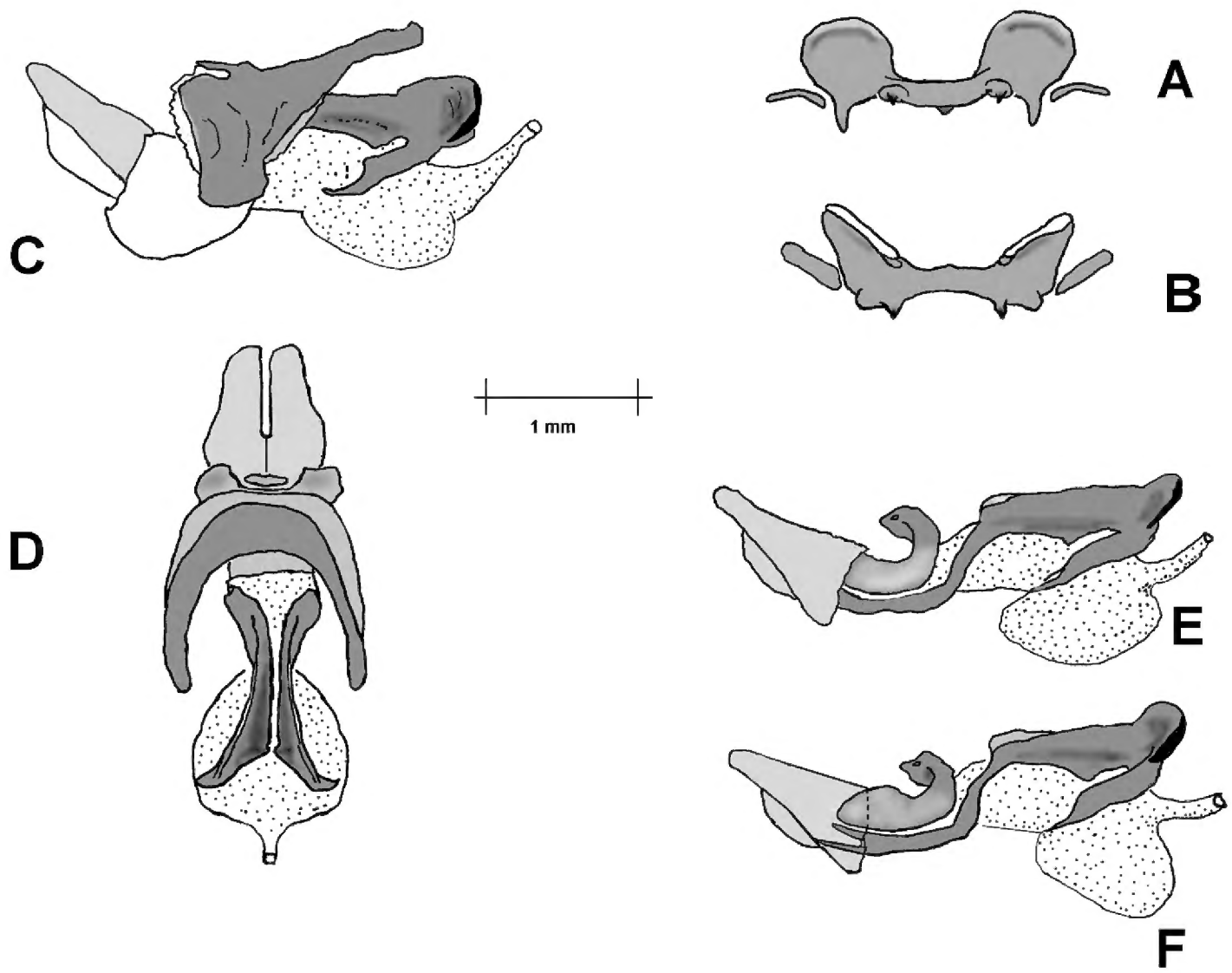


Fig. 6. *Aresceutica lemarineli*, comb. n., phallus. **A.** Epiphallus, axial view; **B.** Epiphallus, dorsal view; **C.** Phallic complex in lateral view, with epiphallus and epiphallic membrane removed; **D.** As in C, but dorsal view; **E.** Endophallus and arch, lateral view; **F.** As in E, but course of dorsal and ventral aedeagal valves inside the aedeagal sheath indicated.

and presented serial transverse sections of the aedeagal region of *Auloserpusia poecila* Jago, 1970 and remarked on its complexity. He wrote "Penis apex therefore consists of a triple sheath: a core of median penis valve and cingular valve, surrounded in turn by sheath derived from ventral side of penis valves and an outer double membranous part attached to posterior side of cingular arch. Penis valves often attached by cuticular material to the outer sheath".

His diagrams support our conclusions in the above description, including the fusion of the aedeagal sclerites with the surrounding ectophallic sheath, and the connections between the arch and the cingular rami. He considered some elements of the aedeagal sheath to be derived from lateral lobes of the arch. We were unable to confirm this with simple dissection techniques.

Comparison with *Serpusia* spp. (Figs 7–8)

The genera *Serpusia* and *Aresceutica* are essentially indistinguishable in their outer morphology. Jago (1970) wrote of them "both the above genera must be defined together" and gave only a single morphological description covering both genera. We find that only the prosternal tubercle separates the two genera reliably. In both species of *Serpusia* this is short, acutely conical and vertical, whereas in all species of *Aresceutica* it is longer, subconical, antero-posteriorly compressed, and tilted somewhat backwards. We therefore examined the phallic anatomy to see whether these are more discriminatory.

The phallic complexes of *S. opacula* Karsch, 1891 (type species of the genus) and of *S. succursor* Karsch,1896 are shown in Figs 7, 8. These are the two species said by Jago (1970) to be "true" *Serpusia* (see Introduction), and they have very similar phalli, close to those of *Aresceutica*, but differing from the latter in a number of details:

1. The complex as a whole is more elongate and less robust than that of *Aresceutica*.
2. The endophallic apodemes are more deeply cupped, and from their ventral margins two channels with a U-shaped cross section run ventrally and posteriorly to form the gonopore processes. The gonopore processes of *Aresceutica* lack this channeled profile, and are longer and more slender, extending further rearwards. As a consequence, the ejaculatory sac, which is bounded by the gonopore processes, is situated more anteriorly in *Serpusia* than in *Aresceutica*, where it is distinctly ventral in position under the basal endophallus.
3. The flexure of the endophallus is very slender in *Aresceutica*, but in *Serpusia* it is thread-like and quite difficult to see at all if the preparation is not stained to visualise the sclerifications.
4. The cingular apodemes of *Serpusia* are long and more or less straight, running roughly parallel to each other distally. They are not curved to form a horseshoe-like profile in dorsal view as in *Aresceutica* (compare Fig. 8C with Fig. 4C or Fig. 5E).
5. The anterior margin of the cingular arch under the zygoma is broadly emarginate in the midline in *Serpusia*, whereas that of *Aresceutica* is straight.
6. The cingular valves are slender and pointed, not short and laterally flattened as in *Aresceutica*. They run along the upper margin of the endophallic valves, but end at the level where the latter enter the aedeagal sheath.
7. The endophallic valves are long and slender, wide and dorsoventrally flattened basally, but laterally compressed and narrow apically. They extend almost to the tip of the ectophallic aedeagal sheath, and are the major component of the aedeagus.

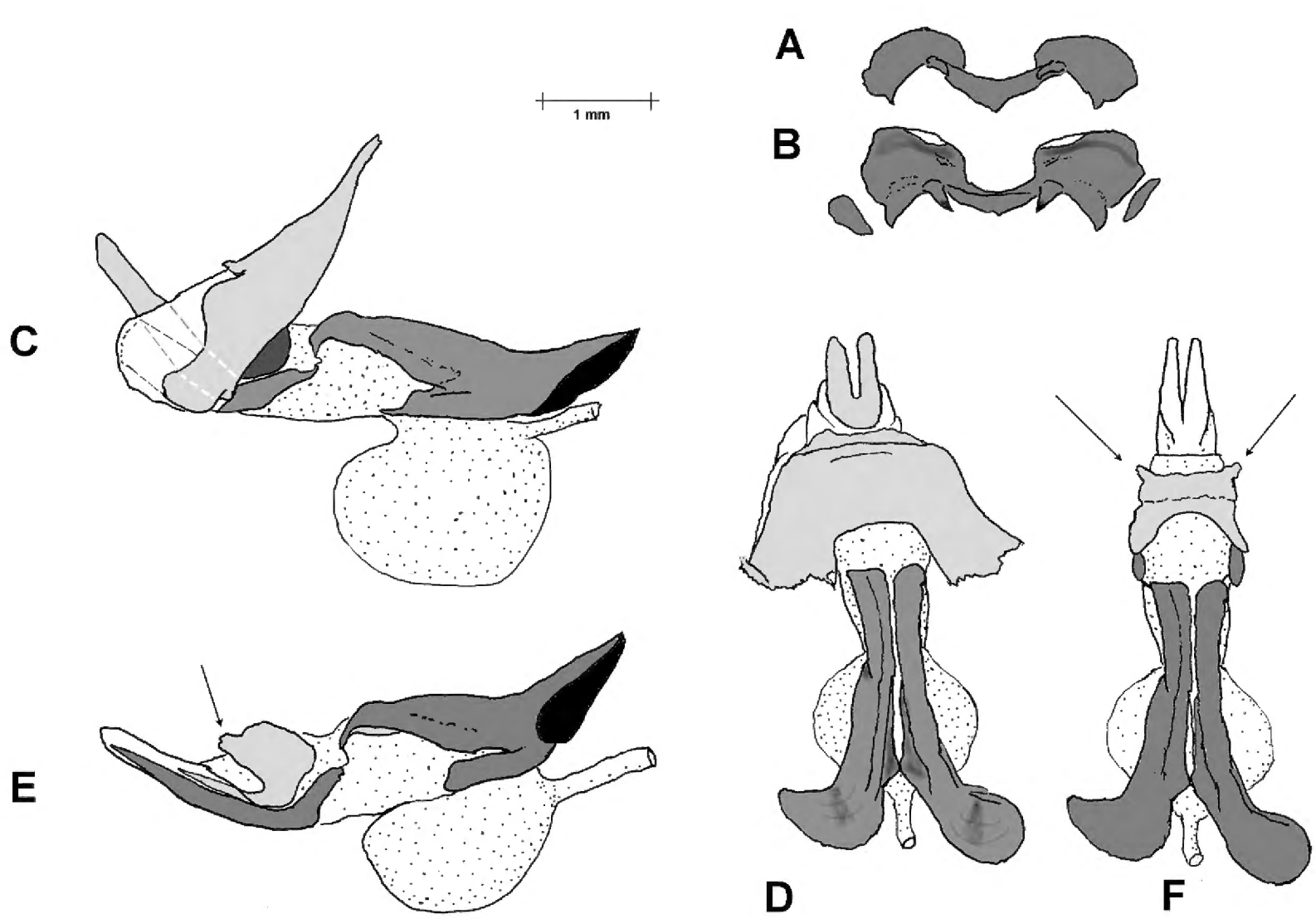


Fig. 7. *Serpusia opacula*, phallus. **A.** Epiphallus, axial view; **B.** Epiphallus, dorsal view; **C.** Phallic complex after removal of epiphallus and epiphallic membrane, lateral view; **D.** As in C, but dorsal view. In this preparation the cingular apodemes are broken off; intact, they resemble those of *S. succursor* (Fig. 8), being long and straight and almost parallel; **E.** Endophallus and arch, lateral view; **F.** As in E, but dorsal view. In E and F, the arrows indicate cut margins of the arch where it has been freed from the inner surface of the zygoma.

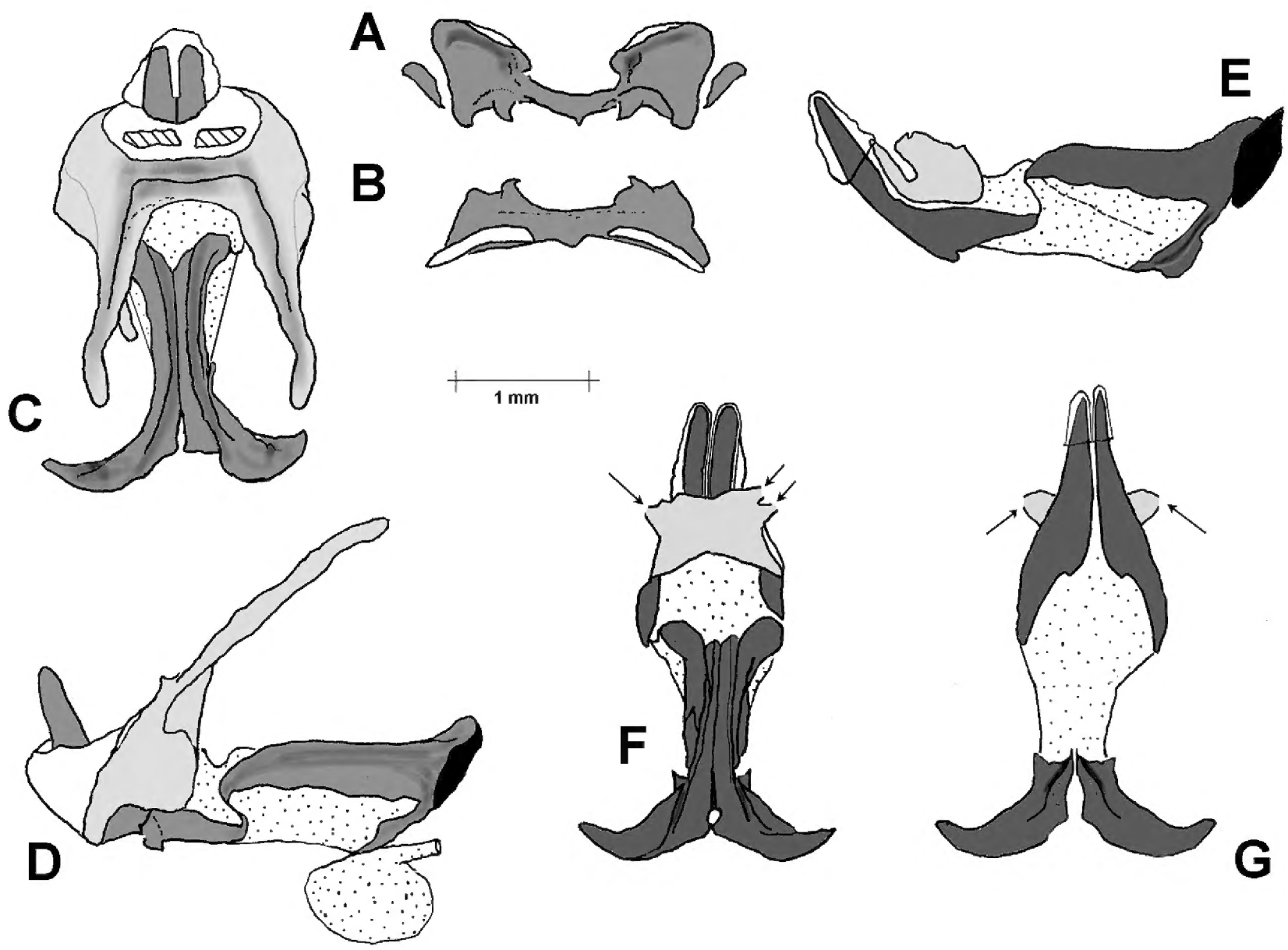


Fig. 8. *Serpusia succursor*, phallus. **A.** Epiphallus, axial view; **B.** Epiphallus, dorsal view. **C.** Phallic complex after removal of epiphallus and epiphallic membrane, dorsal view. The two cross hatched areas are the zones of attachment of the the arch to the inner surface of the zygoma; **D.** As in C, but lateral view; **E.** Endophallus and arch in lateral view; **F.** As in E but dorsal view. The arrows indicate cut margins of the arch where it has been freed from the inner surface of the zygoma; **G.** As F, but ventral view. In E, F and G the ejaculatory sac has been removed to show the detail of the gonopore processes.

8. A complex ectophallic aedeagal sheath envelops the aedeagal valves as in *Aresceutica*, but is much less robust and is closely appressed to the endophallic valves, to which it is attached but not so extensively fused as in *Aresceutica*. In the intact phallus the projecting aedeagus of *Serpusia* therefore looks much more slender than that of *Aresceutica*, due to the wider ectophallic sheath of the latter.
9. The epiphalli of the two genera are similar, but the ancorae of *Serpusia* are stronger and are slanted inwards towards the mid-line, whereas those of *Aresceutica* point directly forwards (compare Figs 6B and 3B with Figs 7B and 8B).

The systematic position of *Duviardia vansomereni* (Kevan, 1956), comb. n. (Figs 2L–M, 9)

Kevan (1956:20) described *Aresceutica vansomereni* from the Aberdare Mts. of Kenya (holotype male, Kenya, Aberdare Mts., Katamayu; in BMNH London). This species differs from the other members of *Aresceutica* in several external features, as was noted by Kevan in his description; he wrote "it differs in its stouter appearance, less strongly compressed and differently shaped prosternal tubercle, in the shape of the tegmina and in the coloration of the male".

Examination of the phallus (Fig. 9) shows that it differs from those of *Aresceutica* species, but is similar to that described by Donskoff (1985) for *Duviardia oubitai*. This resemblance had been previously noted by Jago (unpublished MS). The external morphology of *vansomereni* fits the generic diagnosis of *Duviardia* given by Donskoff (1985) very well, allowing for the fact that the latter was based on only a single species (*D. oubitai*). The supranal plate is not trilobed at its extremity, but this feature is only very weakly seen even in the type species *oubitai*, as shown in Donskoff's (1985) figure, and is absent in *D. fishpooli* Grunshaw, 1990. This character, together with the midline indentations of the anterior and posterior pronotal margins described by Donskoff (1985), seem to be specific to *D. oubitai*, and not properly part of the diagnosis of the genus.

The phallus of *Duviardia vansomereni* is closely similar to those of *D. fishpooli* and *D. oubitai*, and it differs from that of *Aresceutica* in several ways:

1. The aedeagus consists of two pairs of valves (ectophallic and endophallic), both of which are well separated and not fused to an ectophallic sheath at their tips;
2. The arch sclerite is connected to the inner surface of the zyoma by a single medial sclerification;
3. The gonopore processes are very short, causing them to be "éloigné de la flexure", as described by Donskoff (1985).
4. The flexure of the endophallus is wide and robust, not thread-like.
5. The epiphallus is exactly like that figured for the other two species, and has considerably more robust ancorae than seen in *Aresceutica*.

On the basis of these observations, we formally transfer *vansomereni* from *Aresceutica* to *Duviardia*.

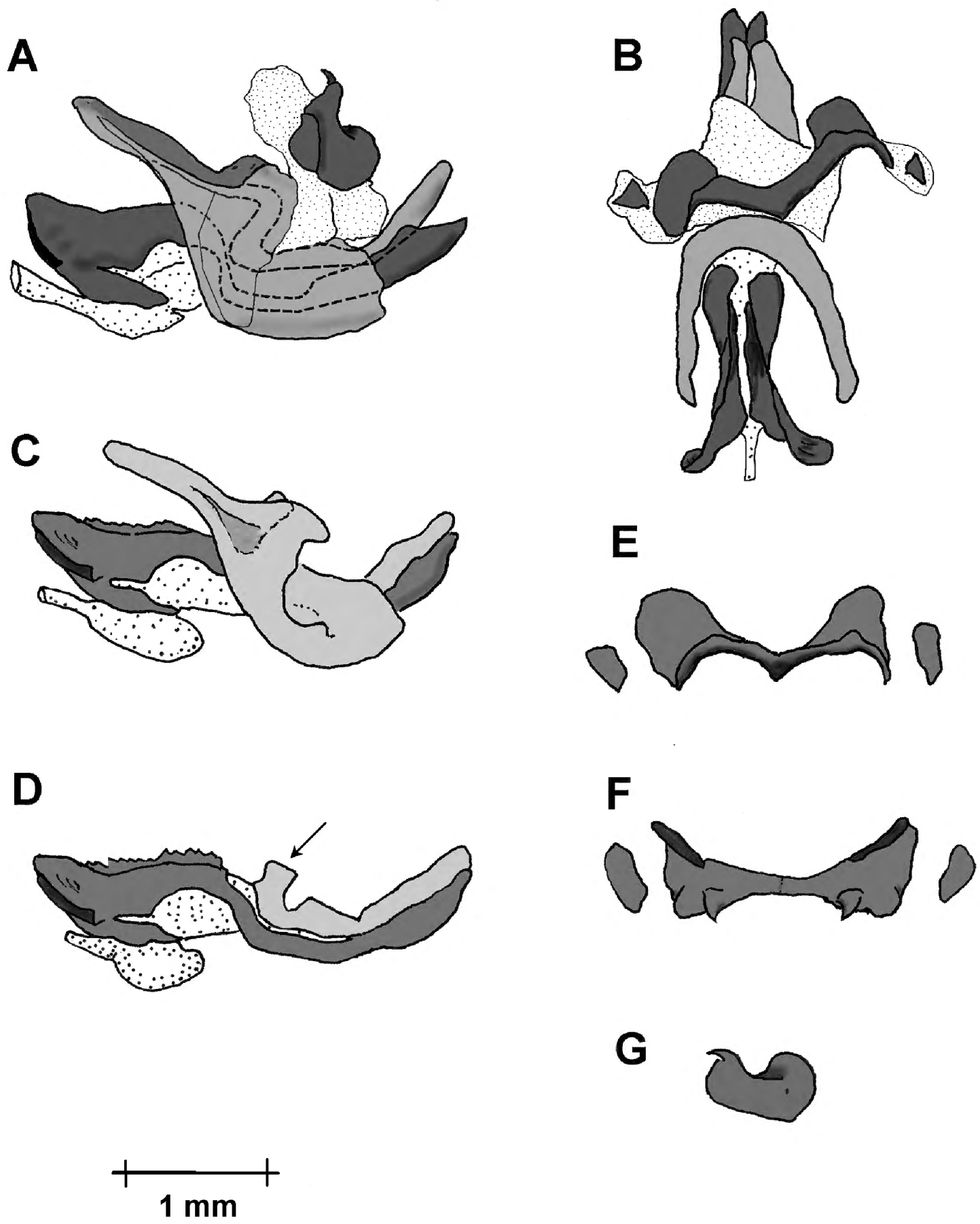


Fig. 9. *Duviardia vansomereni* (comb. n.), phallus. **A.** Entire phallic complex, lateral view. Fine stippling indicates remaining portions of the epiphallic membrane; **B.** As in A, but dorsal view. The epiphallus is twisted out of its normal position in this preparation; **C.** As in A, but entire epiphallic layer removed; **D.** As in C, but after removal of ectophallic cingulum and rami, showing endophallus and ectophallic arch. The arrow indicates the cut edge of the arch sclerite. **E, F, G.** Epiphallus in axial, dorsal and lateral views.

Discussion

Summarizing, comparison of the two genera *Aresceutica* and *Serpusia* indicates that they are very closely related, but distinct; they can be separated by the form of the prosternal tubercle externally and by the detail of the phallus internally. Biogeographically, the two genera are also distinct. *Aresceutica* currently contains four species and is confined to East Africa, with *A. lemarineli* extending into the Eastern Congo. *Serpusia* s. str. occurs in the Western Congo, Cameroon and Eastern Nigeria, and similar genera are found still further West into Guinea and Ghana.

Duviardia now contains three described species, and is known to extend from Ivory Coast to Kenya and Tanzania, though not yet recorded from all the intervening countries; Jago (op. cit.) however considered it likely that several other known equatorial taxa are in fact members of this relatively new genus too.

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We are very grateful to Mrs. Margaret Jago for access to N.D. Jago's unpublished manuscripts, and to Dr. Judith Marshall and other staff of the Natural History Museum, London, for the loan of specimens. Dr. L.D.C. Fishpool kindly took photos of some of the NHML materials for our use, and Mr. C. Oumarou Ngoute provided *Serpusia opacula* material from Cameroon. We thank the authorities of Tanzania, Kenya and Uganda for supplying us with research and collection permits. The publisher's costs were paid by the Orthopterists' Society.

References

Cigliano MM, Braun H, Eades DC, Otte D (2018) Orthoptera Species File Online. http://Orthoptera.SpeciesFile.org [Accessed: 16 January 2018]

Dirsh VM (1955) Contributions à l'étude de la faune entomologique du Ruanda-Urundi (Mission P. Basilewsky 1953). LIII. Orthoptera, Acrididae. Annales du Musée Royal de l'Afrique Centrale (Ser 8vo) Sciences Zoologiques (Tervuren, Belgium) 40: 67–72.

Dirsh VM (1965) The African genera of Acridoidea. Anti-Locust Research Centre and Cambridge University Press, London, 579 pp.

Dirsh VM (1970) Acridoidea of the Congo (Orthoptera). Annales du Musée Royal de l'Afrique Centrale (Ser 8vo) Sciences Zoologiques (Tervuren, Belgium) 182: 605 pp.

Dirsh VM (1975) Classification of the acridomorphoid insects. Classey, Faringdon, Oxon, 171 pp.

Donskoff M (1985) Les acridiens de la forêt Africaine: II. Genres et espèces nouveaux de la foret de Taï (Côte d'Ivoire). Revue française de Entomologie (NS) 7[1986]: 203–214.

Jago ND (1970) A review of the genus *Auloserpusia* Rehn, 1914 (Orthoptera: Acrididae, Catantopinae) and its evolution in eastern Congo and western Uganda. Transactions of the Royal Entomological Society of London 122: 145–183. https://doi.org/10.1111/j.1365-2311.1970.tb00530.x

Johnston HB (1956) Annotated catalogue of African grasshoppers. Cambridge University Press, 833 pp.

Kevan DKM (1956) New East African Acrididae (Orthoptera). Annals and Magazine of Natural History 9: 20–35. https://doi.org/10.1080/00222935608655718

Otte D (1995) Orthoptera Species File 4. Grasshoppers (*Acridomorpha*) C. Orthopterists' Society and Academy of Natural Sciences of Philadelphia, Philadelphia, 518 pp.